

Zero Retries issue 0156 2024-06-14

Zero Retries is an independent newsletter promoting technological innovation that is occurring in Amateur Radio, and Amateur Radio as (literally) a license to experiment with and learn about radio technology. Now in its third year of publication, with 1800+ subscribers.

Radios Are Computers - With Antennas!

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Steve Stroh N8GNJ, Editor

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Web version of this issue - <https://www.zeroretires.org/p/zero-retries-0156>

Request To Send

Commentary by Editor Steve Stroh N8GNJ

Paid Subscribers Update

My thanks to **Prefers to Remain Anonymous 33** for becoming a Paid Subscriber to Zero Retries this past week!

Financial support is a real vote of confidence for continuing to publish Zero Retries.

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Major Conference Countdowns

- [HAM RADIO 2024](#) in Friedrichshafen, Germany on 2024-06-28 thru 30, in 02 weeks!
- [JARL Ham Fair 2024](#) in Tokyo, Japan on 2024-08-24 and 25, in 10 weeks!

...

Zero Retries readers in the Portland, Oregon USA area might be interested in attending the [Teardown 2024](#) conference which will be 2024-06-21 through 23 at the [Lloyd Center](#) (Mall). Teardown 2024 is sponsored by Crowd Supply, which has crowdfunded a number of Zero Retries Interesting radio technology projects. There are a few Zero Retries Interesting talks on the [schedule](#) such as:

- [Open-Source Wireless Sensor Network](#)
- [Unleashing the Power of uSDR: Native Apps, Web Platforms, and Beyond with M.2 SDR](#)
- [Affordable, Portable, Orbital Desktop Satellite Tracker](#)
- [Wireless Hacking on a \\$5 Budget \(with Microcontrollers\)](#)
- [Radio Direction Finding with a KrakenSDR](#) (I think this one would be worth the price of the entire conference).

See other events at the Zero Retries Guide to Zero Retries Interesting Conferences.

New Logo for Zero Retries!



New logo of Zero Retries!

My wonderful wife Tina Stroh KD7WSF created a new logo for Zero Retries to replace the generic satellite dish icon I had been using. Thanks Honey! There will be more “logo” news in the next issue of Zero Retries.

Thought Experiment - A Zero Retries Semi-Official Gathering (ZR SOG)

It's been a favorite thought experiment of mine since beginning Zero Retries to have an in-person meetup of Zero Retries readers... somehow. But considering how thinly we are dispersed around the world, I haven't thought of any good ideas other than choosing a restaurant and evening to do an information meetup in conjunction with a major event like Hamvention. I got this idea from the TAPR informal meetup that was formerly held at a restaurant called (I think...) McNasty's (BBQ) where the talk was “all packet radio” (which, of course, I loved being part of). It looks like McNasty's restaurant has [tranmongrified into a food truck](#). *Hmmm, perhaps lure the McNasty's food truck to a convenient spot near Hamvention?*

The other inspiration for the ZR SOG was the originator (at least, the first time I heard the phrase) was that the SOG was a “conference” (though that crowd would cringe to hear such a formalized description) held for the readers of Micro Cornucopia magazine, such as [SOG III described in the October 1984 issue of Micro-C](#). I miss Micro-C just from wonderful writing by Micro-C's Editor / Publisher David Thompson, such as this:

New Blood

As for attracting new people to Bend [Oregon, USA] (my secret motive, remember?) it looks like I may have succeeded beyond my wildest dreams. Several

individuals and one good size company have either said they are definitely coming (and are presently pouring over multiple-listing books) or are definitely interested in locating here and are exploring ways to do it.

Interestingly enough, it appears that the wives are often the prime motivation in the moving decision. There is something about Bend with its open fields, horse ranches, forests, wilderness areas, and skiing that makes family raising a reasonable (if not genuinely fun) preoccupation. You could think of it as taking on a long-term application project in a really good systems environment.

...

Financial Hard Times

Some folks tried to get their companies to reimburse their expenses but when they passed around our flyer with Semi-Official Get-together on it, their managers didn't feel the event was serious enough. These poor souls suggested we change the name to Super Official Gathering (not to be confused with Superficial Gathering). Maybe next year we'll have two brochures — an official one (for expense accounts) and an unofficial one (for fun).

“*Superficial* Gathering” had me chuckling. Apparently Thompson’s “New Blood” plan *worked*. Per [this web page](#), Bend’s population in 1984 was ~70k, and currently it’s ~210k. In comparison, Bellingham, Washington where I now live was likely < 50k in 1984 and is currently ~92k - a bit less cosmopolitan than Bend... and [attracting more techies all the time](#) - just sayin’.

But, I digress...

Independent of an in-person SOG, in Fall 2024 (let’s not waste too much Summer sitting indoors in front of a computer), I’ll start conducting regular videoconferencing meetings at least monthly. Since they may well be too popular to be conducive to useful discussion, I’ll be capping ZR videoconferences at a “not to exceed” number, and early invitations will go out to the paid subscribers and selected folks like guest authors and Zero Retries Interesting folks that are working on Zero Retries Interesting projects.

On both the ZR SOG and the videoconferences, I welcome ideas from Zero Retries subscribers.

Full-to-Burstin’, This Issue Is!

I have two systems to bookmark items I want to include in Zero Retries. There was so much content this week that I included a handful from one bookmark system, and deferred another article. It’s a nice problem to have, but there’s only so much room in a weekly issue of Zero Retries. I’m imagining ways to incorporate a “Just the Links” with a very terse description, similar to [Amateur Radio Weekly](#), perhaps even a separate issue of Zero Retries that would be available to paid subscribers a week earlier. Nothing has been decided yet, but I welcome ideas from Zero Retries subscribers.

Amateur Radio is Dying... *Right?*

At least that's what the Gloom & Doom faction in Amateur Radio is telling us. The total number of US Amateur Radio Operators is *decreasing*. We've recently *lost CQ and MFJ*. Lots of folks have said they're *not going to renew their ARRL membership* because of the dues increase or Logbook of the World having been hacked. Many... *most* VHF / UHF Amateur Radio repeaters are deathly quiet for 99% of the day. Most HF activity now seems to be *FT8*, *not "real" contacts*. New Amateur Radio Operators pass the Tech test, buy an inexpensive portable radio and say "*Now what? Where's all the excitement?*". The most interesting Amateur Radio content is on *YouTube*. Some "served agencies" are saying to Amateur Radio operators who try to offer emergency communications "*Thanks, but we're good with Starlink, satphones, and FirstNET*". Etc. Ad nauseam.

The Amateur Radio Publishing Industrial Complex posits that the solution is to *join them* (for a small annual fee) and then you get instantly into the mainstream of Amateur Radio. Their flagship publication devotes an entire section to reprinting content from the middle of the previous century (including ads)... *half a century before the current generation was born*. Long time Amateur Radio Operators would have you think that the solution is learn how to solder and build your own rig (using tubes) and put up a massive tower and HF beam antenna for the "Real Amateur Radio" experience. Etc. Ad nauseam.

But, what if that's not the whole story about Amateur Radio in the 21st century?

Amateur Radio is changing - no question about that. But my observation is that such changes are a normal shift resulting from the priorities of a new generation along with better (and cheaper) technology as Amateur Radio is redefined by *this* generation and *new* technologies. Half a century ago, [this was one of the generational challenges confronting Amateur Radio](#) (per 73 Magazine's Wayne Green W2NSD in the 1974-01 issue):

NEW BAND AVAILABLE

As the last few holdouts on two meter AM move on up to the FM end of the band the lower two MHz is developing into a wasteland. Experience has shown us that as soon as anything like this has remained unused for a short while there are vultures just waiting to swoop down ... a la the CB proposal for amputation of the 220 MHz ham band, starting first with the top MHz.

Unless some way is found to get Walker to back down on his firm resolve to limit repeaters to the top two MHz and no more, the repeater channels will inexorably grow more and more crowded and the rest of the band more and more deserted.

Obviously something will have to be done about this.

In this generation of Amateur Radio, a lot of new radios are mostly software, with minimal hardware, built around a powerful processor. (I've encapsulated this profound change in a phrase: Radios are computers - with antennas!) The current generation of Amateur Radio Operators are Internet natives, which means (among other things) that they grew up with ubiquitous text messaging and social media, so data modes "via radio" (like FT8) and one-to-many text communications are the norm for them. A lot of Amateur Radio now involves

Internet connectivity, which is no more a problem for the current generation than “depending on grid power” was for previous generations.

*I created Zero Retries in 2021 because the perspective of the Gloom & Doom faction’s perspective isn’t the whole story of Amateur Radio in the 21st century. Each week in Zero Retries I try to present a variety of stories about the technological innovation *that is happening in Amateur Radio*... that you’ll likely never hear about (at least, substantively) in the “mainstream” Amateur Radio media... or from the Gloom & Doom faction.*

I’m glad to have you 1800+ Zero Retries subscribers along for this wild ride of Amateur Radio in the 21st century.

73,

Steve N8GNJ

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The Innovator’s Dilemma Applied to Amateur Radio Industry

By Steve Stroh N8GNJ

Some thoughts on how the lessons of “The Innovator’s Dilemma” apply to the Amateur Radio industry. ReadyKilowatt’s comment below initiated this article.

ReadyKilowatt commenting on Zero Retries 0155 (excerpt):

At this point I think it might be time to fork radio. Instead of continuing to adapt commercial band equipment to amateur use, maybe it's time to come up with reference designs that are specific to amateur use. Radios that run Linux or Android under the hood. That can be configured and controlled through a web browser (if my \$20 light switch can do it, why can't my \$800 radio?), and can run 25KHz bandwidth (or 6MHz, or whatever I dial up). DMR et al are interesting, but there's no shortage of bandwidth in the amateur bands, so why are we acting like there is (spare me the “no open repeater pairs” argument, how many inactive repeaters still hang on to “their” frequency)? DMR solved a problem we didn't have, and required bodging a fix that doesn't fit into the amateur ethos of VFO and direct operator control. But at least the radios are cheap and can be programmed to police repeaters!

Sorry to be such a downer. Maybe I'm the one who's wrong. But I think we've refined enough. Time to add a few modern features.

I replied at length with a counter-comment. See the link above for my response there, some of which became the basis for this article.

The book [The Innovator's Dilemma](#) had a profound influence on me when I read it within the first year or so after it was published in 1997. It helped me make sense of seeing successful companies with seemingly unassailable, successful products, go down to ruin. Two examples that are front-of-mind to me were Research In Motion (RIM) the creator of the Blackberry personal messenger / mobile phone, and Sun Microsystems. In hindsight of their failures, you could see their corporate hubris, and The Innovator's Dilemma finally explained (at least, to my satisfaction), the thought processes that were behind such failures.

Wikipedia offers a reasonable capsule description:

The Innovator's Dilemma: When New Technologies Cause Great Firms to Fail, first published in 1997, is the best-known work of the [Harvard](#) professor and businessman [Clayton Christensen](#). It expands on the concept of [disruptive technologies](#), a term he coined in a 1995 article "Disruptive Technologies: Catching the Wave".¹ It describes how large incumbent companies lose market share by listening to their customers and providing what appears to be the highest-value products, but new companies that serve low-value customers with poorly developed technology can improve that technology incrementally until it is good enough to quickly take market share from established business. Christensen recommends that large companies maintain small, nimble divisions that attempt to replicate this phenomenon internally to avoid being blindsided and overtaken by startup competitors.

I think those seminal lessons also apply to the Amateur Radio industry, and we will see disruptive technology have a profound effect on most of the currently successful companies and organizations in Amateur Radio by the end of this decade.

With the understanding of “The Innovator’s Dilemma”, I am seeing disruptive technology subtly undermining the foundations of successful companies in Amateur Radio such as Icom, Kenwood, Yaesu, and Elecraft², all of who make expensive HF radios with lots of knobs, but allow little or no customization by users. Companies and organizations within, or adjacent to Amateur Radio are also being disrupted such as:

- SCS, creator of [PACTOR 4](#) is being disrupted by [VARA HF](#).
- [DVSI](#) (CODEC voice chips used in DMR, D-Star, System Fusion, P25) is being disrupted by [Codec 2](#).
- [AMSAT](#)'s satellite construction activity is being disrupted by companies that can provide turnkey “from design to orbit” microsats to any organization (even as small as a local Amateur Radio club who can do an adequate fundraiser) who can pay their reasonable fees. AMSAT is also being disrupted of their requirement of paying a membership fee to view their publication AMSAT Journal by those who are generating enthusiasm for satellite operations without a membership fee such as [YouTube creators](#), [SatNOGS](#), and [TinyGS](#).
- [ARRL](#) is especially poised to be disrupted as its primary income from publishing books on paper, a paywalled magazine, and increasingly high membership dues render it uncompetitive with YouTube channels and free, publicly accessible digital publications

such as the [Surrey Amateur Radio Communications \(club\)'s Communicator](#) Newsletterzine (usually more than 100 pages).

- “Traditional” APRS (1200 bps AFSK AX.25 on 144.39 MHz) is increasingly being disrupted by new interpretations of APRS such as [APRS on HF using VARA HF](#), [APRS using LoRa](#), [Communication And Telemetry System \(CATS\)](#), etc. while the [APRS Foundation](#) is still struggling to offer more than a placeholder website and vague ideas of future directions for the organization.

Some of the “disruptive technology” that is affecting Amateur Radio:

- Changing demographic of new Amateur Radio Operators who trend to be more technically oriented, “space constrained” (apartments and condos, rather than suburban houses), interest in VHF / UHF rather than HF, interest in data modes rather than voice modes, less budget and time for hobbies, etc.
- The Open Source model of publicly sharing software, hardware designs, protocols, standards, etc. The [M17 Project](#) is a good example of this, and of course, the plethora of [Amateur Radio open source projects maintained on GitHub](#) (simple search yields 1300 results).
- Software Defined Radio technology. We’re now firmly in the era of “radios are computers - with antennas” such as the [LimeSDR Mini 2.0](#) and [CaribouLite RPi HAT](#).
- Electronic manufacturers in China who are increasingly willing to do small production lots of custom hardware.
- Virtual organizations organized around videoconferencing rather than local, in-person meetings such as [Radio Amateur Training Planning and Activities Committee \(RATPAC\)](#).
- Increasing use of data communications modes such as [FT8](#) and [JS8Call](#) in lieu of voice and CW (Morse Code) modes on the HF bands.
- Rising radio noise on the HF bands primarily from cheap switching power supplies of which there are dozens in every household are increasingly rendering analog modes on HF less usable.
- Lack of usage of VHF / UHF repeaters except for scheduled nets and linked repeaters that create artificial activity. New Amateur Radio repeaters are put on the air every month, and are briefly popular, but then tend to lapse into silence as they realize that “build it and they will come” increasingly doesn’t work.
- New Amateur Radio Operators are almost always Internet natives versus long time Amateur Radio Operators who spout “well, *that’s* not *real* Amateur Radio”.
- New funding models for small, medium, and large scale Amateur Radio projects (don’t need to form a company, or sometimes even an organization if fiscal sponsors are used):
 - [Amateur Radio Digital Communications \(ARDC\) grants](#),

- Crowdfunding, either privately (such as [KiwiSDR](#)) or with assistance (such as [KrakenSDR](#) via [Crowd Supply](#)).
- Costs of electronic production can be so low, such as inexpensive circuit boards, which allow individual micro businesses such as [Halibut Electronics](#), [digirig](#), and [Mobilinkd](#) to offer products directly to Amateur Radio Operators.
- Artificial Intelligence / Machine Learning / Pattern Recognition on local hardware (not using data center / Internet resources) will inevitably play a profound role in Amateur Radio within a few years. Raspberry Pi now offers a [Raspberry Pi AI kit](#) for \$85.
- Cheap compute power such as the Raspberry Pi products of embedded microcontrollers and computers, all of which are incredibly well-supported with tailored Linux distributions, great documentation, and (now, resuming) ample distribution:
 - [Raspberry Pi Pico](#) (\$4 for a dual core processor), to
 - [Raspberry Pi Zero 2 W](#) (\$15 for quad core, 1 GHz, 64-bit processor), to
 - [Raspberry Pi 5](#) (arguably “desktop class” processing for \$80).
- The breadth of web-based information distribution, versus “exclusivity”. Basically, those who recognize that if your content or product isn’t easily, publicly accessible, it’s essentially irrelevant.
- Constantly shifting social media; “old and tired” is Facebook, X, LinkedIn; “new, hip, and happening” is TikTok, Reddit, and Discord.
- Non Amateur Radio “radio” activity such as [Meshtastic](#) (messaging via mesh network), [SatNOGS](#) (receiving micro research satellite telemetry), [Ribbit / Rattlegram](#) (messaging over any radio using acoustic coupling), rising popularity of [GMRS repeaters](#) for casual chat and emergency communications.

Just as RIM and Sun Microsystems couldn’t / wouldn’t change their products, business models, and organizations to meet the oncoming disruptive technology (until it was too late), I don’t think the current successful Amateur Radio companies have the corporate courage to change their products, business models, and organizations to meet the above disruptive technology (and societal) trends occurring in Amateur Radio outlined above.

One prime example is one Japanese Amateur Radio manufacturer’s *Only Invented In Japan* focus on developing Amateur Radio products in Japan, by Japanese marketers and engineers, largely for the Japan market, and then lightly adapting them for other markets such as the US and Europe. An example of this... “Japan focus”... is that this Amateur Radio manufacturer hasn’t included the US 222-225 MHz band in any of their products developed over the last two decades.

There’s just nothing that can be done. No amount of external warnings, suggestions, recommendations, user feedback, etc. will budge them. Like RIM and Sun, they’re going to stay focused on what *they* think their current market is, and the largest *profits* are at this

moment. If they do see the disruptive technology trends as discussed above coming at them, that's a problem that can be deferred for "maybe next year". The problem with that approach is, of course, there's always going to be a higher priority next year.

Overall, I think that Amateur Radio will be OK, even if we lose major manufacturers from the Amateur Radio market. Amateur Radio has survived the loss of venerable and beloved manufacturers such as [Hallicrafters](#), [R. L. Drake](#), [E. F. Johnson](#), and mighty [Collins](#). There will always be demand for innovative Amateur Radio products, and sophisticated Amateur Radio units, and increasingly those can be accomplished on a small scale with adapting to the new realities and capabilities of this era of Amateur Radio. FlexRadio was deliberately not included in the above examples of "likely to be disrupted" companies because in my opinion, FlexRadio is successfully adapting to the disruptive technology (and societal trends) such as being a truly software-defined radio, offering extensibility and customization by users, and a reasonable and sustainable product lineup. Another example of a "new generation" Amateur Radio unit and manufacturer is the [Charly 25 HF radio by Smart Radio Concepts3](#), based around a family of very powerful software defined transceiver boards (originally intended as a lab instrument) called the [Red Pitaya](#).

Now we just need for a new manufacturer to become the "FlexRadio" of VHF / UHF radios. I keep hoping to see that soon.

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Commentary on What Stalls Amateur Radio Development?

By Steve Stroh N8GNJ

*Some personal commentary on the open letter by Wojciech Kaczmarek SP5WWP in **Zero Retries 0155** - What Stalls Amateur Radio Development?*

In his open letter, SP5WWP highlights some very real issues within Amateur Radio when we attempt to advance Amateur Radio technology. Such work can be taxing to the point where such work can grow the point where it isn't sustainable solely with volunteer labor:

There is a big problem behind it though - volunteers can rarely be bound with any obligations or time constraints. This also means no one can have any expectations against volunteers. They can be distracted, their reliability and commitment can span from anything between extremely enthusiastic to hardly interested. It is understandable that people prioritize tasks in their lives - family and daily job is by far more important for most of us than hobby-related projects.

Just within Amateur Radio, this issue has been known for *decades* now. Some examples of ambitious Amateur Radio projects that ultimately weren't successful because (in my opinion), volunteer labor wasn't sufficient to complete such ambitious projects:

- TAPR announced the [TAPR packetRADIO](#) in 1989... and that project went nowhere

because Radio Frequency (RF) design is hard, and RF design expertise (especially for VHF / UHF) is a rare skillset, especially for volunteer projects. My memory is that TAPR simply could not find enough volunteer RF design expertise to create a stable, reproducible, reasonably priced radio.

It's notable that in the same era, with the same project scope (a data radio for the Amateur Radio market), using professional labor, Kantronics created the [D4-10 Data Radio](#) for 420-450 MHz and the low power [dvr 2-2](#) for 144-148 MHz. Similarly, MFJ was able to create low power data radios for 144-148 MHz and 220-225 MHz. Even more impressive was the [Symek TRX2S and TRX4S radios](#) which were synthesized, with 20 watts output power, and could do data speeds of 150 kbps+.

- [Hubmaster](#) was a project in the 1990s to develop an Amateur Radio networking system that would operate at 256 kbps at 10 watts in the 902-928 MHz band. It was promising, and (if memory serves, there was some limited deployment, but ultimately it didn't become a widely adopted system.
- In **Zero Retries 0000** - Story 3: The Radios That Weren't; Part 1 I discussed the **TAPR Frequency Hopping Spread Spectrum Radio**. Volunteer labor was sufficient to complete this project, but not on a fast-enough timeline; critical parts became obsolete over the course of the project. This happened *twice* before the project was canceled.
- Also in **Zero Retries 0000** - Story 4: The Radios That Weren't; Part 2 I discussed **UDRX-440** by Northwest Digital Radio (NWDR). There were prototypes of this radio developed, but for many reasons, the volunteer labor on the project just wasn't able to complete the critical integration of software and hardware required for that project.
- [FaradayRF](#) was an ambitious project / company to develop Faraday, a data radio that would operate in 902-928 MHz. For reasons unstated, FaradayRF just faded out, likely because of career pressures of the two founders.
- The **RPX-100** was yet another very promising, but ambitious project to create a Software Defined Transceiver for 50 / 144 / 440 MHz, and it also just faded out without creating a viable design (though they did leave behind some great technology, including an RF power amplifier for 50 / 144 / 440 MHz). Interestingly, this project was unique from the above projects in having received a significant grant from ARDC.

What has changed, and what SP5WWP doesn't quite acknowledge in his open letter, is the existence of grants from ARDC now make it much more possible to create new radio technology and systems for Amateur Radio.

Disclaimer - What follows is mostly personal opinion and based on my (often flawed) memory and a bit of "insider knowledge" [from my tenure \(2021-2022\)](#) on the ARDC Grants Advisory Committee (GAC).

I have not been formally involved with ARDC since ending my tenure on the GAC at the end of 2022. ARDC does not speak for me, and I don't speak for ARDC.

To the best of my knowledge, these points are not confidential, and as you'll read, certainly not "secrets" given that paying for professional labor has been prominent in a number of ARDC grants.

Early in my tenure on the GAC, the issue of paying for professional engineering labor, such as developing new software and hardware, came up and was discussed. Some on the GAC felt that “this is Amateur Radio” and Amateur Radio projects should be done almost entirely on a volunteer basis, and ARDC grants should be used to pay for unusual “commercial” expenses such as fabrication of prototypes, test equipment, etc. Ultimately the GAC decided that it was acceptable for an ARDC grant to include payment for professional labor needed to successfully complete a project. Our reasoning was that building radio systems, especially for systems operating above 50 MHz, was a very specialized skillset and anyone with such a skillset was in high demand, with little “volunteer time” available for Amateur Radio projects. Similarly, software engineering for embedded processors and components such as Field Programmable Gate Arrays (FPGAs) was a skillset that was similarly in demand, with little “volunteer time” available for Amateur Radio projects.

I believe that I explained my observations about the TAPR FHSS Radio, and the NWDR UDRX-440, and my conclusion that in this era... creating VHF / UHF radios, and other projects that required specialized skillsets, *simply weren't possible to accomplish without paying for professional labor*.

The GAC, and ultimately the ARDC Board (during my tenure, the board approved, or vetoed, every grant request that the GAC approved) agreed with that perspective. Here are a few selected ARDC grants where paying for professional labor was an explicit part of the grant:

- [Open Research Institute ITAR and EAR Strategy](#) (paid for professional legal labor)
- [NTPsec](#) (paid for professional engineering labor)
- [Fixing the Linux kernel AX.25](#) (paid for hiring professional software developers)
- [Building the Digital Library of Amateur Radio & Communications](#) (paid for hiring of a dedicated Archivist within Internet Archive)
- [GNU Radio Usability Enhancements](#) (paid for hiring software defined radio experts)
- [A Low-Cost Open-Source Universal Radio Test Instrument](#) (paid for hiring a commercial company, which supports Open Source principles)
- [M17 Project Popularization, Research and Development](#) (discussed below)
- [Enhancing HF Digital Voice with FreeDV](#) (paid for hiring professional digital signal processing developers)
- [ZUM Radio: Multimode Digital Voice Modem \(MMDVM\) Project](#) (paid for hiring of a full time software engineer)

There are many other ARDC grants where the hiring of professional labor was not explicitly stated, but can be inferred from the complexity of the project and / or the size of the grant, such as [Improving a State-of-the-Art Free Software Telecommunication Network Stack for the HF Band](#).

What SP5WWP wasn't entirely transparent about is that he is a beneficiary of ARDC's

willingness for its grants to pay for professional labor. For some period, SP5WWP has been working almost entirely on M17 and related projects such as the [OpenHT](#) and Remote Radio Unit) as part of the M17 Project Popularization, Research and Development grant.

Thus, I think that ARDC has already answered (in the affirmative) a least part of SP5WWP's issue. Someone who wants to develop an Amateur Radio project / system / organization (*conceivably*) can receive payment to do such work. But, the caveat of doing so via an ARDC grant is that such work:

- Must be done under the auspices of a qualifying fiscal sponsor such as a not-for-profit organization (in the US, a 501(c)(3) organization or an educational institution), and
- The resulting work must be made publicly available (essentially, released as open source).

As I read SP5WWP's open letter, what I perceive from it as the larger context, is that SP5WWP sees a need for a new kind of organization within Amateur Radio beyond fiscal sponsors - a "Research and Development" organization. If someone interested in Amateur Radio has a unique project in mind that could benefit Amateur Radio, they could apply to work on that project and be paid for that work. The R&D organization would handle the "administrivia" overhead of managing all the other aspects of the project such as working with vendors, managing the "community" that grows up around such a project, and conceivably continuing the project into availability, perhaps even commercial availability. This would allow the "project originator" to focus on the tasks that they are most capable of working on (and have the needed critical skills).

With that context in mind, here are some at least partial answers / opinions:

- At least in name, Amateur Radio actually *has* such an organization - **Amateur Radio Research and Development (AMRAD)**. [AMRAD's About page](#):
The purpose of AMRAD is to develop skills and knowledge in radio and electronic technology, advocate design of experimental equipment and techniques, promote basic and applied research, organize technical forums and symposiums, collect and disseminate technical information and provide repeaters.
I've been told that AMRAD is now largely inactive as several key members such have become Silent Keyboards. But, wouldn't it be cool if AMRAD could be resurrected and reimagined to live up to its name?
If any Zero Retries readers are members of AMRAD, please get in touch - I'm curious about the fate of AMRAD.
- I think that what SP5WWP would like to have is an Amateur Radio equivalent of [Y Combinator](#), a highly specialized venture capital company that helps potential entrepreneurs build a company with unique forms of assistance and investments. In my opinion, such an organization wouldn't be feasible in Amateur Radio as what makes Y Combinator's model possible is a vastly larger potential market than the potential market of Amateur Radio... and vast potential profits. That said... perhaps there's a role for quiet, personal [Angel Investing](#). I've heard rumors of some Angel Investing in Amateur Radio projects; there are a lot of Amateur Radio Operators with significant wealth out there... but I can't offer any specifics.

- [ARDC](#) is not, and cannot (per its legal structure, or perhaps just because of its chosen policies) be such an organization. ARDC can only provide funding via individual grants, and perhaps grant extensions.
- Perhaps ARDC grants could be used creatively to make projects that receive ARDC grants made commercially available. The ARDC grants for *A Low-Cost Open-Source Universal Radio Test Instrument* and *ZUM Radio: Multimode Digital Voice Modem (MMDVM) Project* both involved commercial companies, but it wasn't explained exactly how the "technology transfer" with those companies will ultimately work. My guess is that as long as the work that is paid for by the ARDC grant is made publicly available... the associated commercial company (or any commercial company, or individual, or organization) can make use of that work.
- In previous decades, [TAPR](#) used to provide such a role. For example, TAPR would arrange for writing documentation, providing website support, mailing list support, development of kits, stockpiling parts, sales, after-sales support, etc. TAPR now seems to function mostly as a "sales" organization for smaller projects that are self-developed and self-managed. My impression is that you can no longer come to TAPR with an idea, get funding for the idea, and have support functions provided. *Perhaps* TAPR could be a fiscal sponsor for an ARDC grant, and TAPR could, through its fiscal sponsorship, arrange for "support functions".
- Perhaps... the Radio Society of Great Britain (RSGB) might be at least a partial answer, per this article - [Amateur radio research and development](#):
The RSGB, through its Legacy Fund, has provided funding for projects aimed at supporting innovation. Funding was provided for the ground-breaking work that Dr Martin Sach, G8KDF did on understanding the detailed characteristics of VDSL2, which must surely be the first step in building a method of digitally mitigating its impact on received signals. In the autumn, the RSGB Legacy Fund also subsidised a course organised by John Worsnop, G4BAO designed to encourage radio amateurs to experiment with GNU Radio Companion, and to teach others to do likewise. The Legacy Fund is always looking for proposals for innovative ideas that will advance amateur radio – if you have an idea, please email legacy.chairman@rsgb.org.uk
- In Zero Retries 0079 (2022-12-30), the entire issue was a mostly fictional story about how Amateur Radio organizations might evolve in the near future - A Vision for Zero Retries Interesting Amateur Radio in 2029. Though I didn't imagine a specific Research and Development organization for Amateur Radio, the (*again, fictional*) organization Amateur Radio Standards Organization (ARSO) would at least partially fulfill the role of Research and Development in Amateur Radio.

In conclusion, perhaps the most viable path that I think comes the closest to SP5WWP's vision is to create a very small company and crowdfund a project. The example that comes to mind that is the closest to such an ideal is the very successful [KrakenSDR](#) project, which was crowdfunded (more than \$1.5M to date) through Crowd Supply, by [KrakenRF, Inc.](#) I have no specific knowledge about the principals of KrakenRF, Inc. but in following the project from its announcement, my impression is that the KrakenSDR was developed by a small group of talented folks with an idea for a unique, compelling, and realistic product. KrakenRF, Inc. "put out their vision" via Crowd Supply, and the idea was well-received by enough folks to fund the

project to the point of paying for development and production of the KrakenSDR. Unlike an ARDC grant, with crowdfunding there are no restrictions on how the funds could be used, only some due diligence (one would hope...) by Crowd Supply to verify that KrakenRF, Inc. was likely capable of creating this product per the crowdfunding proposal. The funds raised can then be used, in part, to pay for “administrivia” help so the developer(s) can focus on *development*.

Ultimately, in Amateur Radio, there’s currently no complete solution for developing technology, systems, or products for Amateur Radio and being paid to do so (without contributing one’s own funds, having investors (including bank loans), or obtaining grants. But, as explained in this article, *it is possible* to be paid to work on Amateur Radio projects.

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ZR > BEACON

By Steve Stroh N8GNJ

Short mentions of Zero Retries Interesting items.

[Ashhar Farhan VU2ESE Joins ARDC’s Board of Directors](#)

The team at ARDC is pleased to announce that on March 26, 2024, Ashhar Farhan (VU2ESE), joined our Board of Directors.

Licensed initially at the age of 15 as VU2FAX and “fascinated with electronics as a child,” Farhan became interested in amateur radio after being “hooked” following a local club coming to his school to perform a ham radio demo. Following a hiatus, he returned to the hobby in 2002 and obtained his general grade license as VU2ESE. Active in the amateur radio community, Farhan is the founding Vice President of the [Lamakaan Amateur Radio Club \(LARC\)](#), which he and his friends established in 2012; for the past seven years, the club has hosted an annual convention each December. Through LARC’s collaboration with the [Digital Empowerment Foundation](#), Farhan actively promotes both ham radio and electronics in the inner cities.

Farhan’s technical contributions to amateur radio have earned him inductions into both the [QRP Amateur Radio Club International \(QRPARCI\) Hall of Fame](#) (2016), and the [CQ Ham Radio Hall of Fame](#) (2018). An avid radio and test equipment builder and designer, he is well-known for the [BITX](#), a beginner friendly buildable QRP transceiver that is ideal for operating on 20m and modifiable for operating on other ham bands. The BITX, along with additional buildable transceivers, are available through [HF Signals](#), a company Farhan co-founded with the goal of inspiring people to be active in ham radio around the globe.

Throughout his career, Farhan has worked in the fields of Internet telephony, free software, and voice codecs. An entrepreneur, not only has Farhan founded HF Signals, he has also co-founded [Lamakaan](#), a cultural center in Hyderabad, as well as Exseed Space (now Satellize), which specializes in building satellites: to date, they have launched two amateur radio-carrying satellites into space. In addition to founding the above companies, Farhan is an angel investor in various technology startups.

“I am excited that Farhan agreed to join our Board of Directors,” says ARDC President Bdale Garbee KB0G. “Well-known for his open ham radio transceiver and test equipment designs that enable and encourage learning and experimentation, he also brings a wealth of career experience, and expands our understanding of opportunities and needs to a new geographic region. I am confident that his contributions will be invaluable as we work to achieve our long-term goals.”

“One of the first radios I built early in my ham radio career was Farhan’s BITX 20,” says ARDC Board Member Ria Jairam, N2RJ. “It was from that moment onward that I realized that he was dedicated to making homebrew and open source radios accessible. Farhan’s ideals of experimentation, open source hardware and software align very well with ARDC’s [mission](#). I’m proud that he has decided to join ARDC’s board and look forward to working with him as one of our colleagues to shape the future of open source ham radio.”

“I really and truly am delighted to have him on board,” says ARDC Executive Director Rosy Schechter KJ7RYV. “He’s already bringing a lot to the table, and I can see him playing a key and positive role in ARDC’s continual evolution.”

From my perspective, the addition of VU2ESE to the ARDC Board is not just Zero Retries Interesting, but also a *very welcome development* within ARDC! In my opinion, VU2ESE will add some (needed) *technical* depth to the ARDC board about *radio hardware* technology. He will also add some international perspective as the only ARDC board member not based in the US.

As I mentioned in **Zero Retries 0155** - FDIM 2024 - zBitx - Bringing CW into the 21st Century by Asher Farhan VU2ESE, I am mightily impressed with VU2ESE’s grasp of what’s important in future Amateur Radio, including his choice to use a Raspberry Pi Zero 2 W in the zBitx (future?) radio he discussed, and matter-of-fact inclusion of some data modes in a “QRP CW” radio. He also has a pragmatic perspective of what it takes to drive a project to successful completion via his company, HF Signals and I hope VU2ESE is able to imbue ARDC with that understanding in guiding ARDC’s future grantmaking.

Welcome to ARDC, VU2ESE!

[ARDC Updates Policies Regarding 44Net Subdomains](#)

Rosy Schechter KJ7RYV on the ARDC 44Net email list:

It's been just over two months since we launched the new Portal. It came with, as you have seen, some major bumps. Today, ARDC is resolving, at least temporarily, one of those hurdles: administrative access to subdomains.

As of today, anyone who had a subdomain with ampr.org before the launch of the new Portal on April 3, 2024, will, for now, have full access to their DNS records. This includes subdomains that fall outside of our preferred format of callsign.ampr.org.

This administrative access still depends on call sign verification, which requires confirming given name, family name, email, and valid amateur radio license. This step helps us ensure that the network is being used by valid amateur radio operators. During our recent work, we've found several bad actors, which is both unfair to the community and a security risk.

We've also made a functional change to the portal: once a call sign is verified, you are now automatically able to create a subdomain with the format of callsign.ampr.org. All other new requests for subdomains that fall outside of that format (e.g., foo.ampr.org, which I'll refer to as nonstandard subdomains for brevity) will require review and approval.

Please note that we will be limiting the number of nonstandard subdomains going forward. Thus, if you have one (or, in some cases, many more), **please consider it temporary.** You can currently create as many second-level subdomains as you want—e.g., foo.callsign.ampr.org, bar.callsign.ampr.org, etc.

We are working on a more official policy around subdomains using ampr.org. As promised at the recent regional coordinators' meeting, we will ensure you can see this policy before officially implementing it. We will also provide a transition period, likely many months, for users to edit their entries before official deprecation. This is, ultimately, what we should have done initially, and we take responsibility for not following a better process and, instead, rolling out this change without taking proper preparatory steps.

Some of you may be wondering why we are making this change in the first place. It is because, without doing so, we end up in our current and very unwieldy situation: a database of over 51,000 DNS entries, most without knowledge of who they belong to, accumulated over at least a decade, with very few entries currently in use. If we aim to increase the usage of 44Net, then we need a system where we understand ownership and are able to provide an efficient service where we can address problems as they arise.

For now, we hope that this helps to unblock anyone that currently feels blocked, while also providing an ample notice for changes that are coming down the pipeline at a later, though likely not-so-distant date.

Some long time 44Net users are upset with this policy “modernization”, but in my opinion, seeing it from the perspective of ARDC trying to manage 44Net for the future, and cleaning up

some of the non-allowed usage that has crept in, these new policies seem reasonable. If you want a “cute” name for your 44Net address block, the *cutename.callsign.ampr.org* naming convention seems a reasonable compromise, and in other email discussions, apparently a [cname](#) can also be used.

Another issue that came up is when a 44Net address block is used by a club, and administered by someone who isn't the trustee of the club callsign. Undoubtedly that corner case will be worked out in a reasonable fashion.

A minor issue is the legacy IP address assignments of individual Amateur Radio Operators (some of whom are now Silent Keyboards). For example, the Puget Sound Amateur Radio TCP/IP group had a number of IP address blocks assigned to our various data repeaters in the Seattle area. Those IP address assignments were never cleaned up when that network was shut down. I'm going to try to do my part and go onto the portal and release all my legacy IP address assignments from that era.

Kudos to the ARDC staff, contractors, and the Technical Advisory Committee (TAG) volunteers for apparently working their butts off to sort out all the issues resulting from modernizing 44Net (ticketing system, new policies, real documentation, the eventual 44Net VPN, etc.). With the role of Technical Director vacant, and the recent death of John Hays K7VE (who was highly involved and knowledgeable of 44Net), getting 44Net's issues sorted seems to be an “all hands on deck” priority with ARDC - for the benefit of us Amateur Radio users of 44Net worldwide.

[Technical Aid Group](#)

From the 1974-01 issue of 73 Magazine

The Technical Aid Group is a group of hams who have indicated a willingness to share their knowledge and skills with others. They have volunteered to be of service to fellow hams and do so without compensation. If you have a technical question, look over the list to see who has competency in the area of your question. For many of the TAG members, descriptions of all areas of expertise would be lengthy, so an abbreviated description is given. When stating your problem, give as much information as possible and clearly state the difficulty. Enclose a SASE for reply.

For those hams who have a desire to share, the TAG is the thing for you. Send a brief note requesting the membership form, fill it in and send it back. It asks a few questions about your qualifications, and there is a check-list to indicate your fields of competence. These cover all modes currently used by hams, antenna design and theory, transmitter and receiver design for HF, VHF, and UHF, logic, ICs, general help, and other areas. As more members are added, their names and addresses will be published.

I stumbled onto this in researching one of the articles in this issue. Wow... *what an idea...* and how doable this could be, *in this era*, via a website!

We've kind of done this with email lists for various broad topics (like the various email lists

mentioned in this issue), but there's a lot of value in knowing unique (and searchable) knowledge and potential mentorship.

And, once again, this is an example of how invaluable the **Digital Library of Amateur Radio & Communications (DLARC)** is proving to be for Amateur Radio. *Thank you Kay Savetz K6KJN, Internet Archive, and ARDC (for the grant that made DLARC possible).*

[FreeDV Running Natively on sBitx](#)

Jonathan Bruno W2JON on the digitalvoice email list:

... I picked up an sBitx from HFSignals.com and fell in love with its open-source nature.

If you aren't familiar the sBitx is one of Ashhar Farhan, VU2ESE creations. Big brother to the uBitx, BITX20, BITX40, Antuino, and zBitx.

The sBitx is a hybrid SDR that runs on a Raspberry Pi4 its a hoot to work and play on.

Now, you can buy just the board and experiment but I went all in and picked up the completely assembled unit which comes in an aluminum case with the Raspi 7" capacitive touch screen.

The sBitx software has fldigi in the backend handling some heavy digital lifting and the wsjtx libs are baked into the control surface so the rig can even decode and log FT8 QSOs all in one small box with no additional hardware.

Well, with all that being said, the one thing I wanted to run on it, it couldn't run.. why? the screen is too darn small for the FreeDV GUI.. even with the GUI heavily crunched down it just wasn't useable.

I sat down and thought I wasn't willing to give up the idea of running FreeDV on the sBitx so I set out to write a control companion for the FreeDV codecs.

I'm not a developer by any stretch of the word I'm an infrastructure engineer, but I know enough to be a problem but somehow I got it pretty much working and fairly capable.

I call my abomination FreeDV_PTT [https://github.com/SigmazGFX/freedv_ptt] and If you have an sBitx please feel free to give it a whirl.

But one gotcha. This will only run on the 64bit upgraded OS. (no 32bit).

So now FreeDV has been implemented on a [sBitx](#)... but that *can't be done on a FlexRadio 6000 series*? I guess the moral of this story is never overlook the capabilities of a motivated amateur (as in non-professional) software developer to make something work the way *they* want it to... and the power of user-extensible radio hardware. Kudos to both HF Signals for the

extensible architecture of the sBitx and W2JON for this achievement.

And... yet another example that *Radios are computers - with antennas!*

[Interesting \(and Unusual\) VHF / UHF Antenna Configuration](#)

Stephen Smith WA8LMF on the VARA-MODEM email list:

In the late 1970s, I worked at Collins Radio in Cedar Rapids, Iowa. At the time, repeaters were not ubiquitous as they are today. People routinely used 100-150-watt-plus amplifiers on 2M mobiles to work simplex 50-100 miles (80-160 Km) across the gently-rolling terrain of Iowa to fixed stations with 8-element or more beam antennas. One normally expected mobile flutter and rapid fade-outs/fade-ins as mobiles moved down Interstate-80 at 70 MPH / 110 Kmh. I used two 8-element KLM beams vertically side-by-side fed in phase with a divider harness to produce vertical polarization.

I then tried mounting the two antennas one leaning 45 degrees to the left and the other 45 degs to the right (i.e. 90 degs apart) and fed them with a phasing harness with an extra 1/4-wave of coax on one leg. This creates circular polarization instead of planar vertical-only. The effects were spectacular - the mobile flutter and fading on long simplex paths totally disappeared! Note that you DON'T need to have CP antennas at both ends of the path - the normal vertical-only mobile whip at one end of the path will work as long as the other end of the path has a CP antenna.

I had the same experience with a two-meter repeater covering a narrow canyon road in Los Angeles. The narrow winding rocky-walled canyon road was a nightmare of multi-path phase distortion and rapid-fire fluttering when the repeater at the summit used the usual vertical gain antenna. I switched the repeater to a circular-polarized crossed-yagis antenna intended for satellite tracking pointed down into the canyon. Again, the results were night-and-day - the flutter and spattery audio phase distortion on mobiles in the canyon completely went away.

Imagine combining this technique with a “voting” receiver system now that highly capable, sensitive, and inexpensive Software Defined Receivers are available, not to mention the possibilities of Digital Voice (DV) techniques that incorporate Forward Error Correction (FEC). An interesting subtext is that WA8LMF made this discovery while working for a radio communications company... *as an Amateur Radio Operator in his personal time*. One can only imagine what cool innovations WA8LMF must have contributed within Collins Radio because of his hands-on experiences in Amateur Radio like this.

[Two Books on Software Defined Radio](#)

Joanne Dow W6MKU (I think...) on the SDR-Radio email list:

There is no “one book.” They all have different slants and designed audiences.

"SDR4Engineers" is not as deep as it sounds but deeper than you might like. It is heavily coupled to the [Analog Devices ADALM] Pluto. This is very much how it is done with the math.

"Software Defined Radio Handbook" by Roger Hosking is pretty much a Pentek ad with lots of diagrams. It shows you how the blocks are put together.

Both are free.

I found two likely links for the former:

<https://www.analog.com/en/resources/technical-books/software-defined-radio-for-engineers.html>

<https://archive.org/details/sdr-4-engineers/mode/2up>

It was easy to find the latter with the author's name:

<https://www.pentek.com/sftradhandbook/SftRadHandbook.cfm>

Thank you W6MKU!

Another Great “All Zero Retries Interesting” Issue of The Random Wire!

The [Random Wire Newsletter issue 94](#) is so packed with Zero Retries Interesting items that I'll have to re-read it several times to absorb it all. Recommended!

Kudos to Tom Salzner KJ7T!

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Feedback Loop

Zero Retries 0155 Comments - Only 8 for that issue.

If you provide feedback via email, I may excerpt your feedback or include it in full. Unless you specifically grant me permission to include your name, I won't do so. Feedback may be lightly edited for clarity.

Join the *Fun* on Amateur Radio

If you're not yet licensed as an Amateur Radio Operator, and would like to join the fun by *literally having a license to experiment with radio technology*, check out

Join the Fun on Amateur Radio for some pointers.

Zero Retries Frequently Asked Questions (FAQs) — In development 2023-02.

Closing the Channel

In its mission to highlight technological innovation in Amateur Radio, promote Amateur Radio to techies as a literal license to experiment with radio technology, and make Amateur Radio more relevant to society in the 2020s and beyond, Zero Retries is published via email and web, and is available to everyone at no cost. Zero Retries is proud *not to participate* in the Amateur Radio Publishing Industrial Complex, which hides Amateur Radio content behind paywalls.

My ongoing *Thanks* to:

- Tina Stroh KD7WSF for, well, *everything*!
- **Founding Members who generously support Zero Retries financially:**
 - Founding Member 0000 - Steven Davidson K3FZT
 - Founding Member 0001 - Prefers to Remain Anonymous 01
 - Founding Member 0002 - Chris Osburn KD7DVD
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 - Founding Member 0009 - Prefers to Remain Anonymous 19
- Numerous Annual and Monthly subscribers who also generously support Zero Retries financially!

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- The *most* effective way to support Zero Retries is to simply mention Zero Retries to your co-conspirators that are also interested in knowing more about technological innovation that is occurring in Amateur Radio and encourage them to become a fellow subscriber.
- One particularly effective method of promoting Zero Retries is to add a mention of Zero Retries to your [QRZ](https://www.zeroretries.org) page (or other web presence) and include a link:

<https://www.zeroretries.org>

- If you'd like to financially support Zero Retries, becoming a paid subscriber is *greatly* appreciated and helps offset expenses incurred in publishing Zero Retries. Paid subscriptions for Zero Retries are *entirely optional*, as explained in this special issue of ZR:
Zero Retries Administrivia - Activating Payment Options.

These blogs and newsletters regularly feature Zero Retries Interesting content:

- [Dan Romanchik KB6NU](#) mentions “Zero Retries Interesting” topics so regularly on his blog (that I otherwise wouldn’t know about) that I’ve bestowed on him the honorific of Pseudostaffer.
- [Jeff Davis KE9V](#) also mentions “Zero Retries Interesting” topics so regularly on his blog (that I otherwise wouldn’t know about) that I’ve bestowed on him the honorific of Pseudostaffer.
- [Amateur Radio Weekly](#) by Cale Mooth K4HCK is a weekly anthology of links to interesting Amateur Radio stories that often feature “Zero Retires Interesting” topics.
- [Experimental Radio News](#) by Bennet Z. Kobb AK4AV discusses (in detail) Experimental (Part 5) licenses issued by the US FCC. It’s a *must-read-now* for me!
- [RTL-SDR Blog](#) - *Excellent* coverage of Software Defined Radio units.
- [TAPR Packet Status Register](#) has been published continuously since 1982.
- [Hot Iron - The Journal of the Constructor’s Club](#) is a delightful quarterly newsletter.
- Other Substack Amateur Radio newsletters recommended by Zero Retries.

These YouTube channels regularly feature Zero Retries Interesting content:

- [HB9BLA Wireless](#) by Andreas Spiess HB9BLA
- [KM6LYW Radio](#) by Craig Lamparter KM6LYW (home of the [DigiPi project](#))
- [Modern Ham](#) by Billy Penley KN4MKB
- [Tech Minds](#) by Matthew Miller M0DQW

These podcasts regularly feature Zero Retries Interesting content:

- [Ham Radio Workbench](#) by George Zafiropoulos KJ6VU (and friends)

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Zero Retries (N8GNJ) is on Mastodon — n8gnj@mastodon.radio — just click:

[Zero Retries / N8GNJ on Mastodon](#)

Zero Retries (N8GNJ) is also on Bluesky — [@n8gnj](#) — just click:

[Zero Retries / N8GNJ on Bluesky](#)

Email issues of Zero Retries are “instrumented” by [Substack](#) to gather basic statistics about opens, clicking links, etc.

More bits from Steve Stroh N8GNJ:

- [SuperPacket blog](#) — *Discussing new generations of Amateur Radio Data Communications — beyond Packet Radio (a precursor to Zero Retries)*
- [N8GNJ blog](#) — *Amateur Radio Station N8GNJ and the mad science experiments at N8GNJ Labs — Bellingham, Washington, USA*

Thanks for reading!

Steve Stroh N8GNJ / WRPS598 (He / Him / His)

These bits were handcrafted (by a mere human, not an Artificial Intelligence bot) in beautiful Bellingham ([The City of Subdued Excitement](#)), Washington, USA, and linked to the Internet via [Starlink Satellite Internet Access](#).

2024-06-14

Blanket permission is granted for TAPR to use any Steve Stroh content in Zero Retries for the TAPR Packet Status Register (PSR) newsletter (I owe them from way back).

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Footnotes for this Issue

[1](#)

[Footnote from Wikipedia] Bower, Joseph L. & Christensen, Clayton M. (1995). However the concept of new technologies leading to wholesale economic change is not a new idea since [Joseph Schumpeter](#) adapted the idea of creative destruction from [Karl Marx](#). Schumpeter (1949) in one of his examples used "the railroadization of the Middle West as it was initiated by the Illinois Central". He wrote, "The Illinois Central not only meant very good business whilst it was built and whilst new cities were built around it and land was cultivated, but it spelled the death sentence for the [old] agriculture of the West. "Disruptive Technologies: Catching the Wave" [Harvard Business Review](#), January–February 1995.

[2](#)

The exclusion of FlexRadio from this list is deliberate, as FlexRadio's products are largely software-based, and allow significant user customization through the use of their TCP/IP API and their Waveform API and their update of the product line to the 8000 series with significantly more compute capability as the basis for future capabilities.

[3](#)

Currently being redesigned / updated due to obsolescence of critical parts.